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MARINE AND FRESHWATER STINGRAYS (DASYATIDAE) OF
WEST AFRICA, WITH DESCRIPTION
OF A NEW SPECIES

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ABSTRACT: Three genera and 12 species of stingrays, all members of the family Dasyatidae, are known from West Africa. A key is provided for their identification. The two most common species in shallow coastal waters (including lagoons, estuaries, and river mouths) are the closely related *Dasyatis margarita* (Günther, 1870) and *Dasyatis margaritella* new species, which differ in disc shape, meristic features, and adult size. Two species occur mainly or exclusively in fresh water: *Dasyatis garouaensis* (Stauch and Blanc, 1962) and *Dasyatis ukpam* (Smith, 1863). *Dasyatis garouaensis*, a small, thin-bodied species previously known only from the lower Niger and a tributary, the Benue, is reported from Lagos and the Cross River. It is closely related to *D. margarita* and *D. margaritella*. *Dasyatis ukpam*, a large thick-bodied species with a vestigial sting previously known only from fetal specimens obtained at Old Calabar (without precise information on habitat), is now reported from the Ogooué and the lower Zaire or Congo rivers. It is perhaps related to the genus *Urogymnus*.

INTRODUCTION

This study was undertaken to clarify the systematics, distribution, and relationships of West African freshwater stingrays. Although widely distributed and familiar to local fishermen, stingrays inhabiting the larger rivers of West Africa are poorly known scientifically. There are at least two species. One, *Dasyatis ukpam*, was described more than a century ago, but the two fetal type-specimens obtained at Old Calabar lacked precise habitat data, and the species was not reported again or recognized as valid until the junior author obtained specimens in the

Ogooué basin in 1978. We have also identified a specimen of this species collected in the lower Zaire (Congo) River in 1937.

The other West African freshwater dasyatid, *D. garouaensis*, was described originally as a species of *Potamotrygon*, a genus of the otherwise exclusively Neotropical freshwater family Potamotrygonidae. Evidence that it is actually a member of the family Dasyatidae was advanced by Thorson and Watson (1975). Our own observations fully support this conclusion. Reid and Sydenham (1979) suggested that *D. garouaensis* may be identical with the coastal species *D. mar-*

garita. Our studies, however, indicate that it is a valid species, albeit a close relative of *D. margarita* and the previously undescribed *D. margaritella*. *Dasyatis garouaensis* was known only from the Benue and lower Niger, but the junior author collected a specimen in the Cross River, Cameroun, in 1980, and we have also identified a specimen from Lagos, Nigeria (habitat unknown). So far as we have been able to determine, *D. margarita* and *D. margaritella* occur only in marine and estuarine habitats.

The key below should permit identification of all stingrays now known from West Africa. Following the key we present a definition of the genus *Dasyatis* and detailed descriptions of *D. margarita*, *D. margaritella*, *D. garouaensis*, and *D. ukpam*.

MATERIALS AND METHODS

This paper is based on material deposited in the American Museum of Natural History (AMNH); British Museum (Natural History) (BMNH); California Academy of Sciences (CAS and CAS-SU); Institut für Seefischerei, Hamburg (ISH); Muséum National d'Histoire Naturelle, Paris (MNHN); Musée Royale de l'Afrique Centrale, Tervuren, Belgium (MRAC); and Smithsonian Institution (USNM).

Disc width (measured at widest point) is our standard measure of size, and proportional measurements (unless otherwise indicated) are expressed as percent of disc width. Definitions or explanations of some other terms are as follows:

Disc length—midline measurement from snout-tip to a transverse line parallel to posteriormost extension of pectoral fins

Disc depth—greatest height or depth of disc (usually at scapulocoracoid)

Preorbital length—midline measurement from snout-tip to a transverse line parallel to anterior margin of eyes

Prenarial length—midline measurement from snout-tip to a transverse line parallel to anterior border of nostrils

Prebranchial length—midline measurement from snout-tip to a transverse line parallel to opening of first gill slits

Head length—midline measurement from snout-tip to a transverse line parallel to opening of fifth gill slits

Pectoral fin inner margin—from posterior insertion to posteriormost extension of pectoral fin

Pelvic fin span—distance between apices of pelvic fins when maximally extended

Upper and lower tooth rows—maximum number of tooth rows across upper and lower jaws

Vertebral counts in stingrays are complicated by the extraordinary specialization of the vertebral column as a support for the pectoral fins, and by its termination in an elongate tail, which is frequently damaged. Anteriorly the column is fused into two synarcuals incorporating a variable number of centra. In *Dasyatidae* the anteriormost 23–40 vertebrae are incorporated into the first synarcual. In most of these vertebrae the centra are completely fused, but their number can be determined by counting the spinal nerve foramina. The second synarcual frequently is separated from the first by a small number of intersynarcual vertebrae; in most of the *Dasyatis* herein reported, however, there is only a joint between the two synarcuals. In the second synarcual the centra, although fused, retain their form and are readily counted in radiographs. Sometimes the posteriormost centrum in the second synarcual is sharply distinguished from the monospondylous trunk centra succeeding it. In specimens in which the end of the second synarcual cannot be determined, we give a combined count of second synarcual plus monospondylous trunk vertebrae. This is usual in late fetal or newborn specimens with poor calcification and in heavily denticulated specimens in which this portion of the vertebral column is obscured in radiographs (e.g., in *D. ukpam*). Posteriorly the vertebral column ends in a long series of diplospondylous tail centra followed by a highly flexible, unsegmented rod (apparently consisting of the notochord and a heavily calcified notochordal sheath). The monospondylous and diplospondylous sections of the vertebral column are usually sharply demarcated in radiographs.

For terminology and illustrations of dasyatid clasper morphology see Compagno and Roberts (1982).

Family DASYATIDAE Jordan, 1888

We follow Bigelow and Schroeder (1953) in restricting *Dasyatidae* to the whiptailed stingrays, and tentatively recognize the following genera: *Dasyatis*, *Himantura*, *Hypolophus*, *Taenium*, *Urogymnus*, and *Urolophoides* (see also Compagno and Roberts 1982).

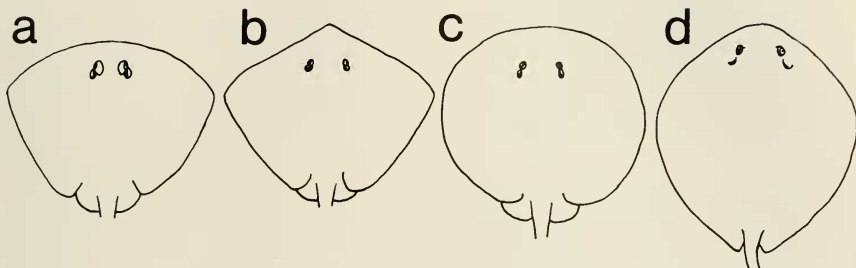


FIGURE 1. Disc shape in West African Dasyatidae. (a) *Dasyatis violacea* (trapezoidal); (b) *Dasyatis centroura* (diamond-shaped); (c) *Taeniura grabata* (circular); (d) *Urogymnus asperrimus* (oval).

KEY TO DASYATIDAE OF WEST AFRICA

- 1a. Disc oval (Fig. 1d); tail without dermal folds; sting invariably absent *Urogymnus africanus* (Bloch and Schneider, 1801)
- 1b. Disc variable in shape, tail with dermal fold or folds, sting usually present (absent in some *Dasyatis ukpam*) 2
- 2a. Ventral tail fold extending to end of tail; disc circular (Fig. 1c) *Taeniura grabata* (E. Geoffroy Saint-Hilaire, 1817)
- 2b. Ventral tail fold ending far anterior to end of tail (*Dasyatis*) 3
- 3a. Disc trapezoidal or diamond-shaped (Fig. 1a–b) 4
- 3b. Disc oval or circular 9
- 4a. Disc trapezoidal, anterior margin broadly rounded, snout not projecting as an angular lobe from disc (Fig. 1a); upper and lower surfaces of disc dark *D. violacea* (Bonaparte, 1832)
- 4b. Disc diamond-shaped, anterior margin angular, snout projecting as an angular lobe from disc (Fig. 1b); lower surface of disc light 5
- 5a. Upper surface of disc with a dark reticular pattern; ventral tailfold very short, about twice length of sting *D. marmorata* (Steindachner, 1892)
- 5b. Upper surface of disc plain; ventral tailfold long, much more than twice sting length 6
- 6a. Entire dorsal surface of disc covered with small denticles; no middorsal row of enlarged denticles or thorns; adults with over 100 rows of teeth in each jaw; disc very broad, about 1.5 times as wide as long in adults *D. rudis* (Günther, 1870)
- 6b. Dorsal surface of disc only partially covered with small denticles, along middle of back, or naked except for a middorsal row of enlarged denticles or thorns; adults with much less than 100 rows of teeth in each jaw; disc narrower, 1.0–1.3 times as wide as long 7
- 7a. Anterior margin of disc anterior to spiracles nearly straight behind snout-tip, with tip projecting; posterior parts of pelvic fins projecting well rearward beyond rear tip of pectoral fins *D. pastinaca* (Linnaeus, 1758)
- 7b. Anterior margin of disc anterior to spiracles slightly concave behind snout-tip, with tip not conspicuously projecting; posterior parts of pelvic fins extending slightly behind rear tips of pectoral fins 8
- 8a. Ventral tailfold high, about as deep as tail above it; a dorsal ridge present on tail behind sting; disc and tail in large juveniles and adults without enlarged, heavy, broad-based denticles, but with moderately enlarged middorsal and scapular denticles only *D. americana* (Hildebrand and Schroeder, 1928)

- 8b. Ventral tailfold low, half as deep as tail above it; no dorsal ridge on tail behind sting; disc and tail in large juveniles and adults with scattered enlarged, heavy, broad-based denticles, forming a mid-dorsal row at center of disc and tail
D. centroura (Mitchill, 1815)
- 9a. Anterior margins of disc broadly convex anterior to spiracles, with tip of snout not projecting from them; dorsal disc surface in juveniles to subadults completely covered with denticles, with flattened large denticles on midbelt, small pointed denticles laterally, and large, conical, erect, sharp-cusped denticles on thorns scattered on disc and tail base; sting reduced or absent; no dorsal keel on tail; base of tail circular in cross section; ventral surface of disc light with a broad dusky marginal band
D. ukpam (Smith, 1863)
- 9b. Anterior margins of disc concave anterior to spiracles, with tip of snout conspicuously projecting from them; dorsal disc surface partially naked, with a mid-belt of flattened denticles and often a midscapular pearl spine, or naked; no large conical thorns on disc and tail base; sting large; a low dorsal keel on tail behind sting; base of tail horizontally oval in cross section; ventral surface of disc light without a broad dusky marginal band 10
- 10a. Back flattened, without an enlarged midscapular pearl spine (sometimes a row of up to 4 moderately enlarged flattened spines in its place); midbelt of flattened denticles reduced or absent, disc sometimes entirely naked; snout long, preorbital length 2.8–3.2 times interorbital space (down to 2.3 in late fetuses or newborn specimens) and 27–32% of disc width; disc very flat, thickness at scapulocoracoid 8–11% (usually less than 11%) of disc width; lateral prepelvic processes of pelvic girdle greatly expanded
D. garouaensis (Stauch and Blanc, 1962)
- 10b. Back somewhat arched, with an enlarged midscapular pearl spine; midbelt of flattened denticles well developed in large juveniles and adults; snout shorter, preorbital length 1.5–2.4 times interorbital space and 19–26% of disc width; disc thicker, 11–15% of disc width over scapulocoracoid; lateral prepelvic processes slightly expanded 11
- 11a. Upper jaw strongly undulated, with teeth greatly enlarged on prominent lateral projections; teeth less numerous, in 26–29/31–34 rows; snout more broadly pointed; pearl spine usually larger and circular, length about 5–6 mm; pectoral radials 133–135; size larger, adults to 65 cm
D. margarita (Günther, 1870)
- 11b. Upper jaw moderately undulated, with teeth moderately enlarged on low lateral projections; teeth more numerous, in 36–42/38–50 rows; snout usually more acutely pointed; pearl spine usually smaller and often axially oval, length 2–4 mm; pectoral radials 116–127; size smaller, adults to 26 cm
D. margaritella new species

Dasyatis Rafinesque, 1810

Dasyatis RAFINESQUE, 1810:16 (type-species *Dasyatis ujo* Rafinesque, 1810 [= *Raja pastinaca* Linnaeus, 1758], by monotypy).

For full generic synonymy of *Dasyatis* see Bigelow and Schroeder (1953).

DIAGNOSIS.—*Dasyatidae* with disc circular, oval, trapezoidal, or diamond-shaped (Fig. 1), its dorsal surface smooth or variably covered with small, flat or prickle-like denticles; large, sharp, spine- or plate-like denticles present or absent on dorsal surface; snout angular or broadly rounded, its projecting tip variably developed; pectoral fins rounded or angular; pelvic bar moderately arched; tail long, slender, with dorsal and ventral folds or ventral folds only; ventral fold not reaching tip of tail; sting usually present (reduced or absent in *Dasyatis ukpam*). Teeth small, rhomboidal, thin-crowned.

Dasyatis as here recognized is a large, heterogeneous assemblage of about 33 species and may be polyphyletic. *Dasyatis margarita*, *D. margaritella*, and *D. garouaensis* are not far removed morphologically from the generic type-species *D. pastinaca*. *Dasyatis ukpam*, however, is distinct, approaching *Urogymnus* Müller and Henle, 1837 in general morphology, heavy den-

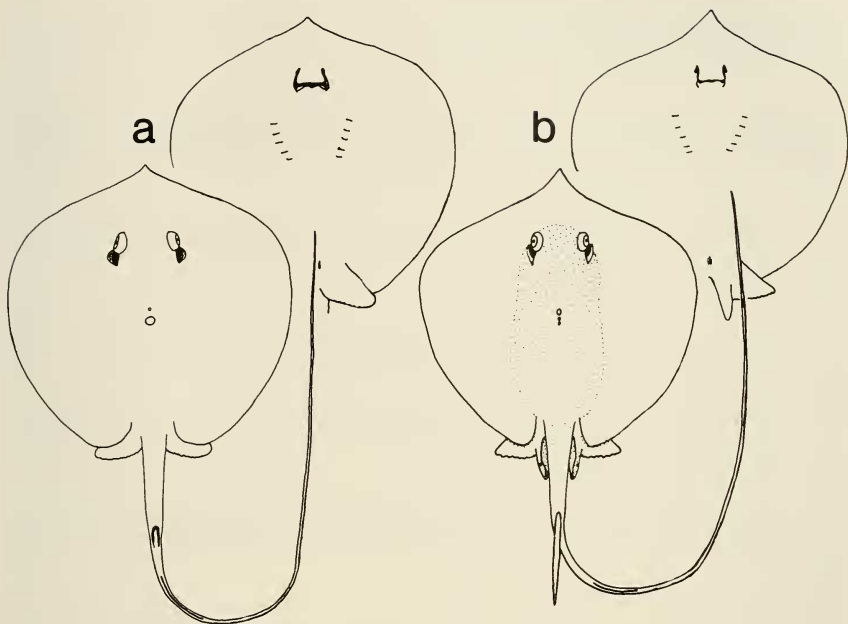


FIGURE 2. (a) *Dasyatis margarita*, lectotype, 200-mm immature female, West Africa (BMNH 1865.7.4:1); (b) *Dasyatis margaritella*, 226-mm mature male, Conakry, Guinea (ISH 183/63).

ticulation, and sting reduction. *Urogymnus* species invariably lack the sting, while specimens of *D. ukpam* either lack the sting or have a very small one. Smith (1863) noted that *D. ukpam* seemed intermediate between *Urogymnus* and *Trygon* (= *Dasyatis*), at least in the nature of its sting, but included it in *Hemitrygon* Müller and Henle, 1837 (= *Dasyatis*) because it has a short ventral tail fold and no dorsal tailfold. We retain *D. ukpam* in *Dasyatis* pending modification of the limits of *Dasyatis* and other dasyatid genera. The species is readily distinguished from known *Urogymnus* species in having a ventral tailfold, much longer tail (less than 1.5 times disc width in *Urogymnus*), a less thick, more circular disc, darker dorsal coloration (dorsal surface pale brown in all *Urogymnus* examined), a dark marginal band on ventral surface of disc, smaller flat denticles on dorsal surface of disc, and in some specimens a small sting.

Dasyatis margarita (Günther, 1870)

(Figure 2a)

Trygon margarita GÜNTHER, 1870:479 (type-locality West Africa).

Dasyatis sp. BLACHE ET AL., 1970:53, fig. 117.

MATERIAL EXAMINED.—BMNH 1865.7.4:1, 200-mm immature female, West Africa (formerly syntype of *D. margarita*; designated lectotype below); USNM 222589, 130-mm late fetal or newborn male, Sierra Leone; BMNH 1930.3.24:3, 212-mm immature male, Accra, Ghana; BMNH 1936.8.20:2–3, 216-mm and 315-mm immature females, Lagos, Nigeria; BMNH 1899.2.20:35, 206-mm immature female, Banana, Congo River mouth, Zaire; AMNH 40408, 235-mm female, Angola.

LECTOTYPE DESIGNATION.—In the original description of *D. margarita* Günther (1870:479) listed two specimens from West Africa without indicating either as holotype:

a. Disk 8½ inches long, tail 19 inches. Purchased of Mr. J. Wood.

b. Young. From the collection of the Zoological Society.

These two specimens are therefore syntypes, but our studies indicate they are not conspecific. Specimen a is BMNH 1865.7.4:1, a 200-mm immature female with a single, large, round pearl

TABLE 1. PROPORTIONAL MEASUREMENTS (AS % DISC WIDTH) AND COUNTS IN FOUR WEST AFRICAN *DASYATIS*.

	<i>D. margarita</i>		<i>D. margartella</i>		<i>D. garouensis</i>			<i>D. ukpam</i>		
	Lectotype 200 mm	Non-types 5:130-315 mm	Types 3:170-191 mm	Non-types 27:109-262 mm	Benue R. 8:68-340 mm	Cross R. 342 mm	Lagos 255 mm	Old Calabar 266 mm	Ogoüté R. 3:499-650 mm	Zaire R. 360 mm
Proportional measurements:										
Total length	335	293-337	318	253-344	290-345		288	378	290-313	
Disc length	103	93-104	100-107	86-111	105-114		111	107	100-103	100
Disc depth	13.0	13.1-14.5	12.6-15.3	11.0-15.3	8.7-11.0	10.5	9.8	14.3	14.8-15.7	13.3
Eyeball	5.5	5.6-7.0	7.3-8.2	6.5-9.2	4.8-9.0	5.8	5.9	5.6	4.0-4.6	5.0
Cornea	4.5	3.4-3.8	5.2-5.5	3.0-6.0	2.9-7.7	4.1	3.9	4.1	2.6-2.9	2.8
Interorbital width	12.5	10.0-12.7	11.0-12.7	9.2-12.6	9.0-11.8	9.9	10.2	12.0	12.0-13.8	13.6
Spiracle	7.0	6.9	5.2-6.5	5.9-7.4	5.6-7.4	6.4	5.5	9.0	7.4-8.0	7.5
Interspiracular width	19.0	16.2-20.3	17.8-19.3	14.5-20.0	11.3-22.1	15.2	16.1	18.0	17.4-18.4	18.3
Nasal curtain	6.0		5.2-5.9		4.2-5.9	5.3	4.7	4.5	5.8-6.2	5.3
Internarial width	8.0	7.3-8.5	8.4-10.0	6.9-11.4	4.8-6.3	6.1	6.7	9.0	8.8-9.4	8.9
Mouth width	8.5	9.2	6.6-8.4	7.6-9.2	5.9-7.7	7.0	7.5	8.3	8.1-9.4	8.6
1st gill slit	3.0	3.1	2.1-2.4	2.4-3.4	1.5-3.0	2.3	2.4	3.0	3.3-3.5	3.3
5th gill slit	2.5	2.3	1.0-1.8	1.6-2.3	1.3-2.1	2.3	1.6	3.0	2.7-2.9	2.5
1st interbranchial width	23.0	20.8	19.9-22.9	20.7-22.5	16.4-23.5	17.3	18.4	23.7	23.6-23.8	23.1
5th interbranchial width	14.0	12.3	11.0-12.9	12.8-15.5	10.9-16.7	11.1	11.8	16.2	16.2-16.6	15.8
Preorbital length	23.0	19.4-22.8	23.6-25.4	19.8-23.8	27.8-32.2	28.7	29.4	22.9	21.4-22.5	23.1
Prenarial length	18.0	15.9-17.5	20.9-21.8	17.1-21.6	22.1-27.4	24.9	26.3	19.2	15.5-17.0	17.8
Preoral length	24.5	21.5	25.1-28.2	24.8-27.1	27.9-33.7	28.9	32.2	23.7	20.9-21.9	22.8
Prebranchial length	35.0		37.7-39.4		39.9-44.9	40.6	43.1	36.5	33.3-34.8	34.4
Head length	49.5		49.7-53.5		49.7-59.0	52.0	54.1	50.4	48.9-49.4	48.3
Prepelvic length	83.5		84.8-90.1		82.1-96.2	90.6	87.5	89.5	82.8-83.1	81.7
Snout-tip to vent	83.5	78.5	84.8-89.0	81.4-87.2	85.3-97.2	89.2	88.2	90.2	82.5-85.8	82.8
Pectoral inner margin	14.5		11.5-12.9		11.3-14.7	14.0		10.2	11.1-12.2	11.4
Pelvic anterior margin	18.0	18.0-20.8	18.3-21.5	13.2-22.2	19.8-25.0	22.2	24.3	19.2	16.0-17.3	18.3
Pelvic posterior margin			14.1-16.1		20.0-22.8	22.2		15.0	19.0-23.1	18.3
Pelvic fin base	13.5		10.6-14.4		10.9-15.0	12.9	15.3	8.6	12.6-16.2	12.8
Pelvic fin span			47.5-47.6		51.8-52.4	49.7		45.1	45.8-48.1	41.6
Tail base width	8.0	8.5-10.2	8.4-9.4	7.0-11.1	7.1-10.3	8.5	7.8	6.8	6.7-7.4	6.9
Tail base depth	5.5	6.9	5.0-5.8	4.4-6.4	4.5-6.4	5.3	4.3		5.8-6.5	6.1
Counts:										
Oral papillae	5		5		5(2)	5		4	5	5
Spiral valve turns	14	12-13	13-14		10(2)	11		20	20	19
Upper tooth rows	29	26-30	36-43	35-43	32-33(2)	40		46	38-44	38
Lower tooth rows	31	31-34	42-49	38-50	37-40(2)	45		43	38-48	41
Total pectoral radials	135	133-134	117-121	116-127	122-124	125	124	146	142-149	144

TABLE 1. CONTINUED

	<i>D. margarita</i>		<i>D. margaritella</i>		<i>D. garouaensis</i>			<i>D. ukpan</i>		
	Lectotype 200 mm	Non-types	Types	Non-types	Benue R. 8:68-340 mm	Cross R. 342 mm	Lagos 255 mm	Old Calabar 266 mm	Ogooué R. 3:499-650 mm	Zaire R. 360 mm
		5:130-315 mm	3:170-191 mm	27:109-262 mm						
Propterygial radials	58	55-56	50-51	49-50	53-56	56	55	65	65-70	64
Mesopterygial radials	18	17-21	16-19	15-22	16-20	18	17	20	17-19	22
Metapterygial radials	59	59-60	50-54	51-56	49-52	51	52	61	59-64	58
Pelvic radials male			22-24	20			23	23		
Pelvic radials female	28		27		29	29			28-34	25+
Total vertebral segments	162			139-151	157-162	149	162	155(1)		
Total separate centra	130		116-124	119-128	128-131	120	126	122	108-120	
1st synarcual segments	34			25-28	33-35	31	40	38		
1st synarcual free centra	2		2-4	5	3-7	2	4	5	2-5	0
Intersynarcual centra	0		0	0	0-2	0	0	0	0	0
2nd synarcual centra					20-26	18	13			
2nd synarcual + monosp.	45		42-44	40-42	37-42	40	41	45	44-50	39
Diplospondylous	77		63-66	61-77	83-88	78	81	72	57-65	
Post-sting centra	6		9-13	6-11	11-17	5	9	0	0	0

spine; specimen *b* apparently is BMNH 1852.8.30:23, a 116-mm fetal or newborn male with two relatively small oval pearl spines. Günther's description clearly is based mainly on specimen *a*, which we therefore designate as lectotype. Specimen *b* belongs to *D. margaritella*.

DIAGNOSIS.—A large marine and estuarine *Dasyatis*, 65 cm or more, most closely related to the much smaller marine and estuarine species *D. margaritella* and to the extremely flat freshwater species *D. garouaensis*. Pearl spines always present and very large (much smaller in *D. margaritella* and absent or represented by 2-3 low denticles in *D. garouaensis*). Denticles on dorsal surface of disc smooth, restricted to middle portion.

Disc oval, moderately flat, its medial lobe broad-based and moderately exerted, its anterolateral margin somewhat concave; disc depth 13.0-14.5% of disc width, disc width 0.9-1.1 times disc length; snout moderately long, preoral length 22-24% of disc width; dorsal surface of disc naked in young (except for pearl spine), but in older individuals (larger than about 200 mm) middle third of disc covered with small, circular, flat denticles and tail covered with small prickles; no enlarged thorns on disc or tail; a massive, usually circular, button-shaped pearl spine on back, 4.8-5.5 mm long; usually a single large slender sting on tail, its length 22% of disc width in newborn; eyes moderately large and somewhat elevated, eyeball length 1.4-2.3 times in interorbital space, interorbital space 1.5-2.0 in preorbital length; spiracles moderately large and flattened; floor of mouth with 5 elongate papillae; total tooth rows 26-30/31-34; pelvic fins short, anterior margins 18-21% of disc width; tail evenly tapering to a slender whiplash behind sting, but broad opposite and in front of it, its length when intact about 1.8-2.5 times disc width; base of tail horizontally oval and depressed in section; ventral tailfold moderately high, dorsal tailfold reduced to a low keel behind sting; disc and pelvic fins gray-brown above, without spots or prominent markings, uniformly pale or whitish below; intestinal valve turns 12-14; total pectoral radials 133-135; total vertebral centra 130, and total vertebral segments 162; vertebral centra extending behind origin of sting; a moderately large stingray, exceeding 65 cm.

Proportional measurements (as percent of disc width) and counts are given in Table 1. Preoral length 2.5-3.0 times internarial width and about 1.0 times width between first gill slits. Snout fair-

ly broad, angle in front of eyes 123° . Spiracle length 1.0–1.3 times eyeball length, 0.8–0.9 times internarial width, and 1.8–2.0 times in distance between fifth gill slits. Nasal curtain with a fringed, weakly trilobate posterior margin. Mouth weakly arched, midline of lower jaw with a prominent indentation; a shallow to deep, curved groove extending posteriorly from posterior nasal flap around corners of mouth. Floor of mouth with 5 papillae, including a transverse row of one small medial and two large elongate paramedial papillae, and two smaller lateral papillae near ends of dental bands.

Teeth in quincunx pavement, with crowns closely adjacent to one another. Teeth similar in upper and lower jaws, upper and lower jaw teeth about equally large at symphysis, varying continuously lateral to symphysis, largest and most elongate at or near symphysis and smallest and least elongate at mouth corners. Upper dental band with a prominent knob of considerably enlarged teeth at symphysis, separated from similar, very large knobs at either side by depressions with smaller teeth; lower dental band with a well-marked symphyseal depression into which symphyseal knob of upper jaw fits, and a pair of prominent lateral knobs fitting into depressions in upper dental band.

Dorsal surface naked except for pearl spine in young below about 200 mm, but in larger specimens moderately large, heart-shaped or circular denticles form a middorsal belt of denticles on disc; lateral parts of disc naked. Larger individuals with small conical prickles on dorsal surface of tail behind sting.

Neurocranium, observed in radiographs, similar to that of *Himantura signifer* as described by Compagno and Roberts (1982) but with longer, more ovate nasal capsules.

Pelvic girdle (Fig. 10e) broadly arched, semi-circular, and relatively narrow, with a medial angle but without a medial prepubic process. Lateral prepubic processes low, rounded, lobate, and not greatly expanded; iliac processes well developed; ischial processes short. Four obturator foramina present.

Claspers not studied in detail, but morphologically similar to those of *D. garouaensis*.

***Dasyatis margaritella*, new species**

(Figures 2b, 3)

Trygon margarita GÜNTHER, 1870:479 (in part).

Dasyatis margarita BLACHE ET AL., 1970:53, fig. 116.

HOLOTYPE.—CAS-SU 68915, 190-mm male, Mbode, Cameroun, A. I. Good, 7 December 1940.

PARATYPES.—CAS-SU 68916, 169-mm male and 180-mm female, same collection data as holotype.

ADDITIONAL MATERIAL EXAMINED BUT NOT INCLUDED IN TYPE-SERIES.—BMNH 1852.8.30.23, 116-mm immature male, West Africa, apparent syntype of *Trygon margarita* Günther, 1870; USNM 222590, 4 immature males, 109–139 mm, 2 females, 132–164 mm, and USNM 222593, 3 immature males, 129–141 mm, 146 mm female, both lots from Guinea-Bissau; ISH 141–142/62, 3 immature males, 135–196 mm, 201-mm adolescent male, 228-mm adult male, 3 females, 149–222 mm, Guinea; ISH 183/63, 226-mm adult male and 248-mm female, Conakry, Guinea; ISH 295/59, 167-mm immature male, Dubreka, Guinea; USNM 222591, 145-mm female, Liberia; BMNH 1920.8.12.1, 262-mm female, Sierra Leone; USNM 222591, 149-mm female, Liberia; BMNH 1914.11.2.75, 133-mm female, Lagos, Nigeria; BMNH 1937.4.19.4, 208-mm adult male, Lagos Lagoon, Nigeria; AMNH 41515, 204-mm female, Congo River mouth.

DERIVATION OF NAME.—*margaritella*, diminutive of Latin *margarita*, f. “pearl”; for the smaller size of this stingray and of its pearl spine, as compared to *D. margarita*.

DIAGNOSIS.—*D. margaritella* is a marine species and the smallest dasyatid in West Africa. Males sexually mature at 208 mm or less; largest known specimen a 262-mm female. Most similar to the marine species *D. margarita*, which attains over 600 mm, has a larger pearl spine, and more numerous pectoral radials (133–135 vs. 116–127). It is also similar to *D. garouaensis*, a freshwater species with a much flatter disc and a longer snout.

Disc oval, moderately flat. Medial lobe broad-based and exerted, its anterior margin concave. Disc depth 11.0–15.5% of disc width, disc width 0.9–1.1 times disc length; snout moderately long, preoral length 25–27% of disc width; dorsal surface of disc naked in young (except for pearl spine), but above about 130–140 mm middle third of disc covered with small heart-shaped or circular flat denticles and tail posterior to sting with small prickles; no enlarged thorns on disc or tail; a moderately large, usually longitudinally oval pearl spine on back, 2.4–4.1 mm long; usually a single large slender sting on tail, 24–32% of disc width; eyes moderately large and somewhat elevated, eyeball length 1.2–1.9 times in interorbital space, interorbital space 1.7–2.4 in preorbital length; spiracles moderately large and flattened; floor of mouth with 5 elongated papillae; total tooth rows 35–43/38–50; pelvic fins short, anterior margins 13–22% of disc width; tail evenly tapering to a slender whiplash behind sting, but broad oppo-

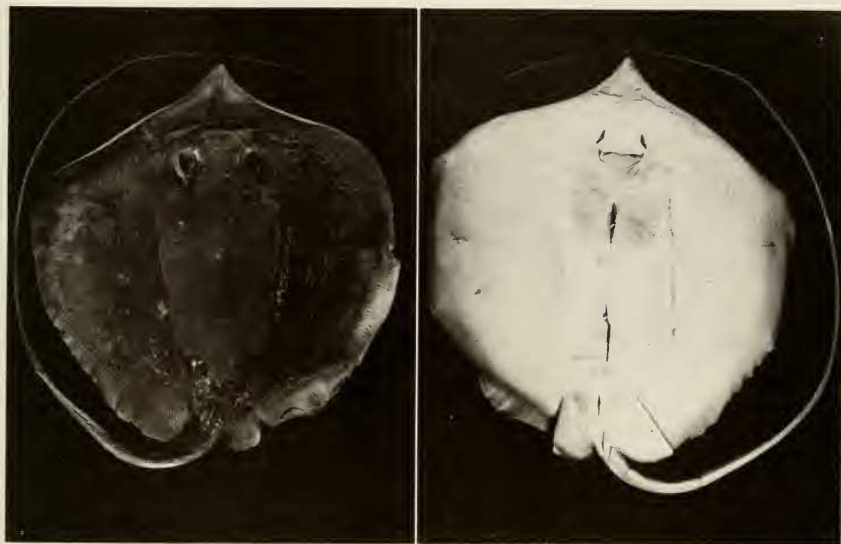


FIGURE 3. *Dasyatis margaritella*, holotype, 190-mm immature male, Mbode, Cameroun (CAS-SU 68915).

site and in front of it, its length from vent to tip when intact about 2.5–3.4 times disc width; base of tail horizontally oval and depressed in section; a moderately high ventral tailfold present but with only a low keel on the dorsal surface of the tail behind the sting; disc and pelvic fins gray-brown above, without spots or prominent markings, white below and without a marginal dark band; intestinal valve turns 13–14; total pectoral radials 116–127; total vertebral centra 116–128, and total vertebral segments 139–151; vertebral centra extending behind origin of sting. A small stingray, probably not exceeding 30 cm.

Proportional measurements (as percent of disc width) and counts are given in Table 1. Preoral length 2.5–3.3 times internarial width and 1.1–1.3 times width between first gill openings. Snout fairly narrow, angle in front of eyes 113–119°. Spiracle length 0.7–1.1 times eyeball length, 0.6–0.9 times internarial width, and 1.8–2.5 times in distance between fifth gill openings. Nasal curtain with a fringed, nearly straight or weakly trilobate posterior margin. Mouth weakly arched, midline of lower jaw with a prominent indentation; a shallow-to-deep, curved groove extending posteriorly from posterior nasal flap around

corners of mouth. Skin on ventral surface of lower jaw more or less corrugated and papillate. Palate behind fringed maxillary valve with three strong, short ridges, a medial longitudinal ridge and a pair of diagonal lateral ridges. Floor of mouth with 5 oral papillae, including a transverse row of one smaller medial and two larger elongated paramedial papillae at midline of mouth, and two smaller lateral papillae near ends of dental bands.

Upper jaw with about 6, lower jaw with about 8 functional series of teeth. Teeth in quincunx pavement, close-set, with crowns closely adjacent to one another. Teeth similar in upper and lower jaws; uppers about as large as lowers at symphysis, varying continuously lateral to symphysis; teeth largest and longest relative to width at or near symphysis and smallest and shortest at mouth corners. Upper dental band with a prominent knob of slightly enlarged teeth at symphysis, separated from similar knobs at either side by depressions with smaller teeth; lower dental band with a well-marked symphyseal depression into which symphyseal knob of upper jaw fits, and a pair of prominent lateral knobs that fit into depressions in upper dental band.

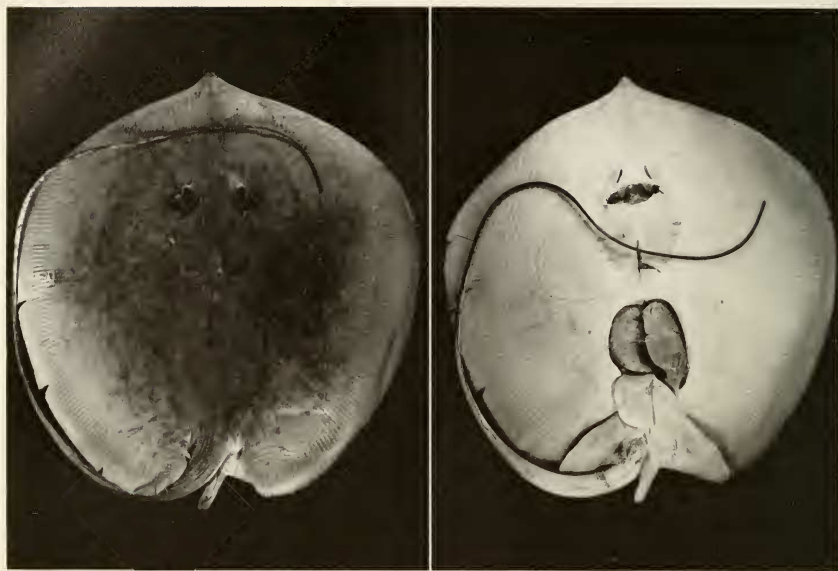


FIGURE 4. *Dasyatis garouaensis*, 340-mm mature male, Benue River at Makurdi, Nigeria.

Teeth of both jaws with low, broad-tipped, cusplless, rhomboidal crowns that have a transverse blunt keel or carina, reticulating ridges on their labial sides, a strong basal ledge, and concave, inset basal groove separating crown and root. Roots moderately large, fairly low, pedicellate, bilobed basally, with a transverse groove and nutrient foramen. Teeth of adult males somewhat longer than in females, but without elongated cusps.

Dorsal surface naked in young below about 130–140 mm, except for pearl spine, but in larger specimens moderately large, heart-shaped or circular denticles form a middorsal belt of denticles on disc; lateral parts of disc naked. Also, small conical prickles on dorsal surface of tail behind stinging in larger individuals.

Neurocranium, observed on radiographs, similar to that of *Himantura signifer* as described in Compagno and Roberts (1982), but with longer, more ovate nasal capsules.

Pelvic girdle (Fig. 10f) broadly arched, semicircular, relatively narrow, with a medial angle but without a medial prepubic process. Lateral prepubic processes low, rounded, lobate, not

greatly expanded; iliac processes well developed; ischial processes short. Four obturator foramina present.

Claspers not studied in detail, but similar morphologically to those of *Dasyatis garouaensis*.

***Dasyatis garouaensis* (Stauch and Blanc, 1962)** (Figures 4–5)

Potamotrygon garouaensis STAUCH AND BLANC, 1962:166, fig. 1–4 (type-locality Benue River at Malape, Cameroun); DAGGET AND STAUCH, 1963:85–107 (reference); CASTEX, 1967:167–176 (discussion).

Dasyatis sp. KREFFT, 1968:70, pl. 6 (“Rafin Kunama, Nebenfluss des Nigers etwa 300 Meilen oberhalb der Mündung”).

Dasyatis garouaensis CASTELLO, 1973:67 (placed in *Dasyatis*);

THORSON AND WATSON, 1975:701–712 (placed in *Dasyatis*, size, range, physiology, additional specimens reported from Niger and Benue rivers of Nigeria and Cameroun); REID AND SYDENHAM, 1979:46, 54–55 (possibly synonymy with *D. margarita*, range in Benue River system); COMPAGNO AND ROBERTS, 1982:321 (reference).

MATERIAL EXAMINED.—MNHN 1962-303, holotype, 202-mm female; MNHN 1962-304, 68-mm male and 78-mm female fetuses; MNHN 1967-441, 263-mm female; MNHN 1967-440, 300-mm adult male; MNHN 1967-439, 340-mm adult male; all from upper Benue River, Cameroun; CAS 49147, 342-mm adult female, Cross River, 5–10 km downstream from Mamfe, Cameroun; CAS 53108, 311-mm female, 340-mm

adult male; Thorson collection, uncat., 238-mm female (radiograph only); Benue River at Makurdi, Nigeria; BMNH 1949.10.24.1, 255-mm adult male, Lagos, Nigeria.

DIAGNOSIS.—A moderately large and thin-bodied freshwater dasyatid. Largest known specimen a 342-mm adult female. Disc flatter than in any other West African dasyatid, its depth only 8.7–11.0% of disc width (vs. 11.0% or more in other species). Denticles on dorsal surface of disc highly variable, sometimes absent, always restricted to central portion. Pearl spine absent or represented by 2–3 low denticles. Most similar to the small marine species *D. margaritella* and the larger marine species *D. margarita*, both of which have well-developed pearl spines and shorter snouts.

Disc oval, very flat. Medial lobe fairly broad-based and elongated, its anterior margin straight or concave; disc width 0.9–1.0 times disc length; snout moderately long, preoral length 29–32% of disc width; dorsal surface of disc either entirely naked or with scattered, small, heart-shaped or circular flat denticles on its middle, no pearl spines (a few slightly enlarged, flattened, heart-shaped denticles occasionally present in midscapular area), and no enlarged conical denticles on disc and tail; a single, large, slender sting present on tail; sting 22.6–26.3% of disc width in adults; eyes small and hardly elevated, eyeball lengths 1.3–2.0 times in interorbital space; interorbital space, 2.4–3.2 times in preorbital length; spiracles moderately large and flattened; floor of mouth with 5 elongated papillae; total tooth rows 32–40/37–45; pelvic fins short, their anterior margins 20–25% of disc width; tail rapidly tapering to a slender whiplash behind sting but broad opposite and in front of it, its length from vent 2.5–3.5 times disc width when intact; base of tail horizontally oval and depressed in section; a moderately high ventral tailfold present but with only a low keel on dorsal surface of tail behind sting; disc and pelvic fins medium gray or gray-brown above, without spots or prominent markings, white below and without dark margins; tail darker or blackish, mottled, lighter below, underside of base white; intestinal valve turns 10; total pectoral radials 122–125; total vertebral centra 120–131 and total segments about 149–162; vertebral centra extending posterior to sting origin.

Proportional measurements (as percent of disc width) and counts are given in Table 1. Preoral

length 4.0–6.0 times internarial width and 1.2–1.9 times width between first gill slits. Snout moderately broad, angle in front of eyes 110–116°. Spiracle length 0.9–1.2 times eyeball length, 0.8–1.2 times internarial width and 1.8–2.1 times in distance between fifth gill slits. Internal gill openings with close-set transverse ridges on gill arches, apparently serving as gill rakers. Nasal curtain with a fringed, concave posterior margin. Mouth nearly straight, midline of lower jaw slightly concave. A groove extending posteriorly from posterior nasal flap around mouth corner. Skin on anteroventral surface of lower jaw corrugated and papillate. Palate behind heavily fringed maxillary valve with three strong short ridges, a medial longitudinal ridge and a pair of diagonal lateral ridges; two short ridges also present behind the three palatine ridges. Floor of mouth with a transverse row of three elongated oral papillae, a larger medial papilla and a smaller lateral one behind each end of dental band; a pair of additional large papillae just behind and lateral to medial papilla. Upper jaw with 5–7 and lower jaw with 7–9 functional tooth series. Teeth in quincunx pavement, close-set, with crowns adjacent to one another. Teeth similar in upper and lower jaws, uppers slightly larger than lowers; teeth varying continuously lateral to symphysis, largest and longest relative to width at or near symphysis, smallest and shortest near mouth corners. Upper dental band with a small knob of slightly enlarged teeth at symphysis, separated from similar weak knobs on either side by depressions with smaller teeth; lower dental band with a corresponding symphyseal depression into which upper symphyseal knob fits, and a pair of very low lateral knobs which fit into upper parasymphyseal depressions. Teeth of both jaws with moderately high (females) to very high (males), peaked, broad-tipped (females) or acutely pointed, cuspidate (males) crowns shaped like mushroom caps, with a strong, sharp cutting edge (males) or a broad, blunt carina or transverse keel (females), a strong basal ledge, and a concave, inset basal groove separating crown from root. Root small, moderately high, pedicellate, bilobed basally, with a transverse groove and nutrient foramen. Dentition sexually dimorphic; teeth of males with triangular, concave, cuspidate crowns; females with low, rhomboidal, truncated, cusplless crowns.

Dorsal surface of disc either completely naked, without denticles (2 fetuses, the holotype, and a

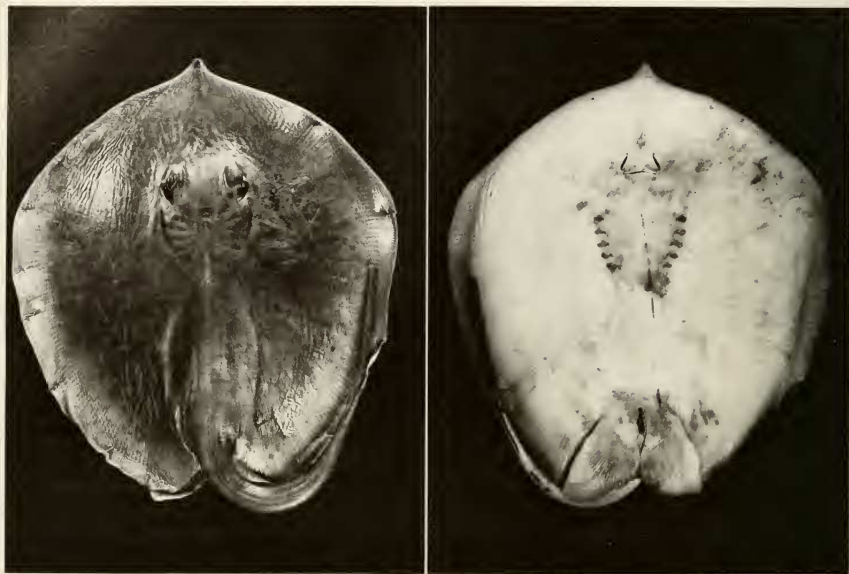


FIGURE 5. *Dasyatis garouaensis*, 342-mm mature female, Cross River near Mamfe, Cameroun (CAS 49147).

340-mm adult male), or with a variable number of small, heart-shaped or circular denticles buried in skin on middorsal area (remainder of specimens examined). Two large specimens (including 342-mm male from Mamfe) have a few scattered denticles along midline of back; two others have a small rectangular area of flat denticles centered on midscapular region but not extending outwards to cover middle third of disc as in *D. ukpam*, *D. margarita*, and *D. margaritella*. Five large specimens had 3 or 4 large, flattened, wedge-shaped denticles in midscapular region, but these not formed as domed, rounded pearl spines (although probably homologous to pearl spines).

Neurocranium, examined from radiographs, generally similar to that of *Himantura signifer* as described in Compagno and Roberts (1982), except frontoparietal fontanelle shorter and broader, and posterior margin of nasal capsules more transverse; width of nasal capsules about 75% of nasobasal cranial length.

Pelvic girdle (Fig. 10c-d) less arched than that of *D. ukpam*, convex anteriorly and without a medial prepubic process or a median angle. Pel-

vic girdle of *D. garouaensis* differs from that of *D. ukpam* as well as *D. margarita* and *D. margaritella* in having large, laterally expanded lateral prepelvic processes; these were prominent on all *D. garouaensis* radiographed, including specimens from Mamfe, Lagos, and Benue River in Nigeria and Cameroun. Pelvic girdle also with short ischial processes, long, slender iliac processes, and 4 obturator foramina.

Claspers of adult male short and stout, length of outer margin 10.2–11.6% of disc width, oval in cross section and somewhat depressed; height about $\frac{3}{5}$ of width at midlength. Dorsal surface of clasper slightly flattened, ventral surface broadly convex, lateral edge convexly arched, medial edge undulated, and tip bluntly pointed. Apophyle on anterodorsal surface, connected to hypophyle by an open, posteriorly curved clasper groove. Clasper glans simple, dorsal lobe supported by dorsal marginal and terminal cartilages, ventral lobe supported by ventral marginal and terminal cartilages as well as ventral covering piece. No structures inside hypophyle. A large pseudopoda laterally situated on ventral lobe below hypophyle; a small pseudosiphon on dorsomedial surface of

dorsal lobe, its cavity lying entirely below flange of dorsal marginal cartilage. Ventral lobe without clasper spur or associated terminal (T_3) cartilage). Clasper skeleton simple, with two cylindrical basal segments connecting pelvic basipterygium to axial cartilage. Axial cartilage cylindrical, nearly straight, with rodlike tip reaching ends of terminal cartilages. Beta cartilage present, a long, slender, separate, flattened plate running along lateral surface of clasper skeleton from posterior end of basipterygium to anterior end of dorsal marginal cartilage. Dorsal marginal cartilage broad and subquadratriangular, with a diagonally truncate posterior edge, broad medial flange, and narrow lateral flange that forms roof of clasper groove. Ventral marginal cartilage a narrow, laterally expanded plate on axial cartilage, with a straight lateral margin forming floor of clasper groove. Dorsal terminal cartilage large, broad, wedge-shaped, and axially convex, with a broad anterior base articulating with posteroventral edge of dorsal terminal, a narrow posterior tip opposite tip of axial cartilage, and medial edge articulating with axial cartilage. Ventral terminal cartilage large, complex, oval, and scoop-shaped, with a broad, arched, lateral flange forming roof of pseudopera and a recurved, expanded posteroventral tip forming a partial floor for it along with ventral covering piece. Ventral covering piece large, elongate-oval, broadly convex ventrally, and scoop-shaped, enclosing terminal cartilages and rear tips of marginals ventrally.

Dasyatis ukpam (Smith, 1863)

(Figures 6–9)

Hemitrygon ukpam SMITH, 1863:69 (type-locality Old Calabar River, Nigeria); FOWLER, 1936:126 (placed in synonymy of *D. centroura*); FOWLER, 1969:186 (in synonymy of *D. centroura*).

Trygon ukpam GÜNTHER, 1870:480 (description after Smith, 1863, placed in *Trygon* = *Dasyatis*).

Dasyatis margarita LOUBENS, 1964:11 (freshwater lakes south of Lambarene district, Ogooué basin; presumably no specimens preserved).

Dasyatis ukpam STEHMANN, 1981:4 (in key to marine *Dasyatis* of West Africa); COMPAGNO AND ROBERTS, 1982:321 (reference).

MATERIAL EXAMINED.—BMNH 1874.5.23.1, syntype, 266-mm late fetal male, Old Calabar River, Nigeria; USNM 219780, 520-mm immature female, Lake Ezanga, Ogooué River system, Gabon; CAS 42761, 650-mm immature female, Lake Ezanga near Nzame-Akesile village, Ogooué River system, Gabon; MNHN 1979-244, 499-mm immature female, Bououé, Ogooué River, Gabon; MRAC 55778, 361-mm immature female, Binda, Congo (Zaire) River, Zaire.

DIAGNOSIS.—*D. ukpam* is a very large and

thick-bodied freshwater dasyatid, probably growing much bigger than our largest specimen, a 650-mm immature female. Newborn young, 266 mm, are as large as the largest known *D. margaritella* and far larger than newborn young of *D. margarita* and *D. garouaensis*. Entire dorsal surface of disc covered with stout-spined denticles (smooth in newborn) (peripheral portions of disc without denticles in all other West African dasyatids except the very large marine species *D. centroura*, with a diamond-shaped disc, and *Urogymnus*, with an extremely thick disc). Sting greatly reduced in size or absent (sting invariably absent in *Urogymnus* but normally present and relatively large in all other West African dasyatids).

Disc oval, very thick. Medial lobe narrow-based and short, its anterior margin broadly convex; disc depth 13.3–15.7% of disc width, disc width 0.9–1.0 times disc length; dorsal surface of disc entirely covered with denticles at all free-living stages except possibly newborn; small, heart-shaped or circular denticles covering middle of disc, small prickles on sides of disc, with scattered large, conical, stellate, sharp denticles (absent in newborn and fewer in small immatures than large) and usually 1–3 small to moderate-sized midscapular pearl spines on disc; no sting, or a single small, possibly vestigial one, only 6.5% of disc width in 520-mm specimen; eyes small and strongly elevated, eyeball lengths 2.1–3.3 times in interorbital space; interorbital space 1.5–1.9 times in preorbital length; spiracles large and high; floor of mouth with 4 or 5 elongated papillae; total tooth rows 38–46/38–48; pelvic fins short, anterior margins 16–19% of disc width; tail uniformly tapering to a slender whiplash, its length from vent when intact 2.0–2.9 times disc width; base of tail circular in section; a very low ventral tailfold but no dorsal fold or keel; disc and pelvic fins dark brown or gray-brown above, without spots or prominent markings, white below except for broad dark margins; tail blackish except for underside of its base; intestinal valve turns 19–20; total pectoral radials 142–148, total vertebral centra 108–122 and total segments 155 (in one specimen), vertebral centra ending in front of sting or extending to its origin.

Proportional measurements (as percent of disc width) and counts are given in Table 1. Preoral length 2.3–2.6 times internarial width and 0.9–1.0 times width between first gill openings. Snout broad, angle in front of eyes 123–132°. Spiracle

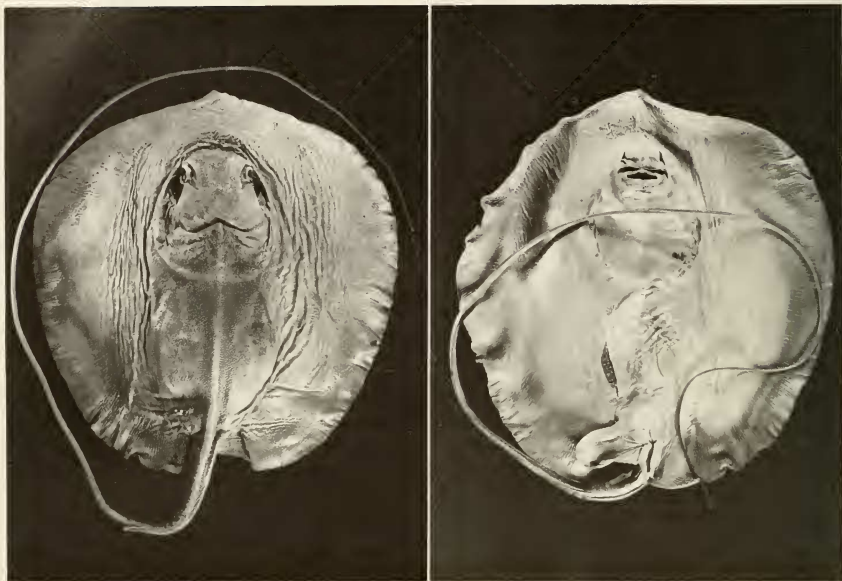


FIGURE 6. *Dasyatis ukpam*, 266-mm fetal male syntype, Old Calabar, Nigeria (BMNH 1874.5.23:1).

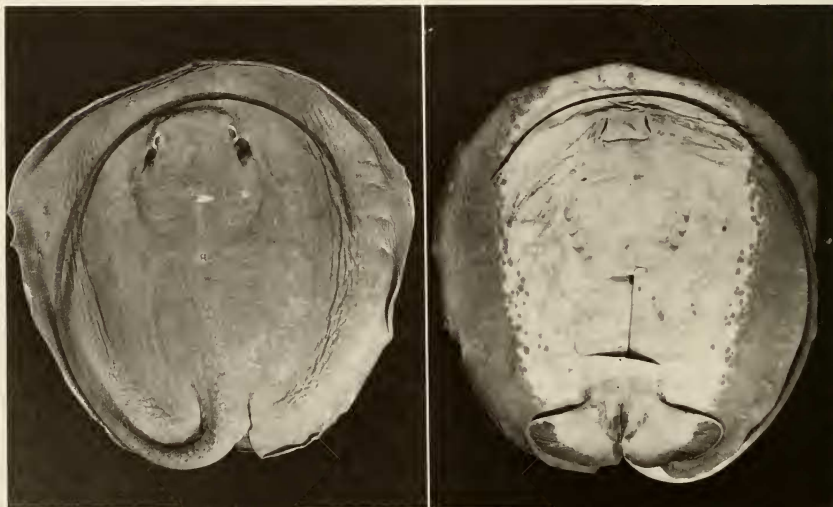


FIGURE 7. *Dasyatis ukpam*, 650-mm immature female, Lake Ezanga, Ogooué basin, Gabon (CAS 42761).

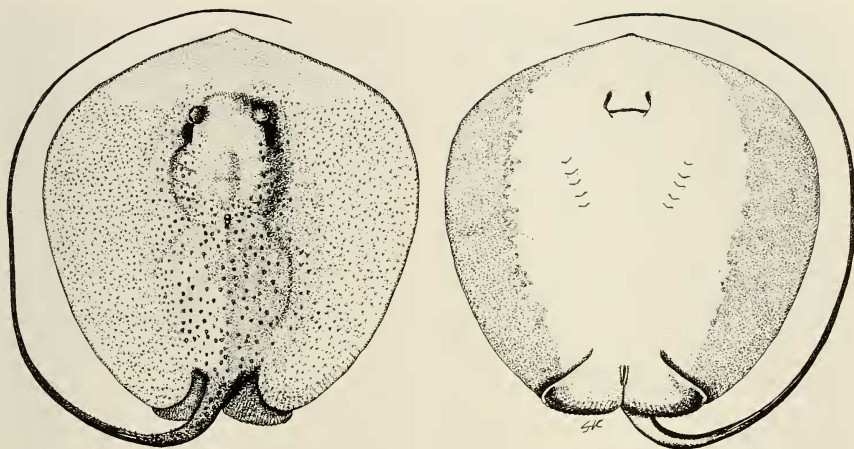


FIGURE 8. *Dasyatis ukpam*, 520-mm immature female, Lake Ezanga, Ogooué basin, Gabon (USNM 219780).

length 1.5–2.0 times eyeball length, 0.8–1.0 times internarial width, and 1.8–2.2 times in distance between fifth gill openings. Internal gill openings with close-set transverse ridges on gill arches. Nasal curtain with a fringed, slightly concave or

trilobate posterior margin. Mouth weakly arched, midline of lower jaw slightly indented; a shallow to deep, curved groove extending posteriorly from posterior nasal flap around corners of mouth. Skin on ventral surface of lower jaw more or less



FIGURE 9. *Dasyatis ukpam*, 361-mm immature female, lower Zaire River at Binda, Zaire (MRAC 55778).

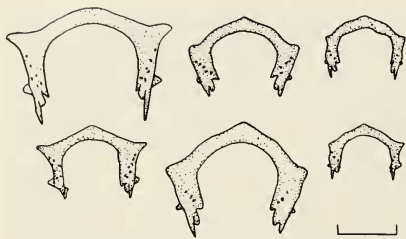


FIGURE 10. Pelvic girdle (dorsal view) in West African *Dasyatis*: (a) *D. ukpam*, 266-mm fetal male; (b) *D. ukpam*, 361-mm immature female; (c) *D. garouaensis*, 342-mm mature female; (d) *D. garouaensis*, 255-mm adult male; (e) *D. margarita*, 200-mm immature female; (f) *D. margaritella*, 190-mm mature male. Note prominent lateral prepubic processes in *D. garouaensis*. Scale bar = 2 cm.

corrugated and papillate. Palate behind fringed maxillary valve with three strong, short ridges, a medial longitudinal ridge and a pair of diagonal lateral ridges. Two pairs of long, low ridges behind the three palatine ridges. Floor of mouth with a transverse row of usually three moderately large, elongated oral papillae, a medial papilla (absent in syntype) and a lateral papilla behind each end of dental band; a pair of large papillae just behind and lateral to medial papilla.

Upper jaw with about 4 and lower jaw with 6 functional tooth series. Teeth in quincunx pavement, close-set, with crowns closely adjacent to one another. Teeth similar in upper and lower jaws, uppers slightly larger than lowers at symphysis, varying continuously lateral to symphysis, teeth largest and longest relative to width at or near symphysis and smallest and shortest at mouth corners. Upper dental band with a low knob of slightly enlarged teeth at symphysis, separated from similar knobs on either side by depressions with smaller teeth; lower dental band with a weak symphyseal depression into which symphyseal knob of upper jaw fits; a pair of low lateral knobs fit into depressions in upper dental band. Teeth of both jaws in females with moderately high, broad-tipped, cusplike crowns shaped like mushroom caps, with a transverse, blunt keel or carina, strong transverse ridges on both labial and lingual sides, and a strong basal ledge and concave, inset basal groove separating crown and root. Roots moderately large, high, pedicellate, bilobed basally, with a transverse groove and nutrient foramen. Teeth of adult males

unknown, but probably differ from those of females.

Dorsal surface of 266-mm late fetus covered with small flat denticles on middle third of disc and base of tail to its abbreviated sting, including dorsal surface of cranium, branchial region, scapular region, and abdominal area; in addition, specimen has two small, slightly elevated, enlarged rounded denticles or pearl spines in mediscapular area. The larger, free-living specimens examined have outer two-thirds of disc, snout, and tail posterior to sting region with small to moderately large, conical, prickly-like denticles in addition to flattened denticles covering mid-belt; they also have massive, conical, erect, fluted, sharp denticles or thorns over much of dorsal surface of disc and tail base. Large thorns fewest on smallest (361-mm) specimen, most numerous on largest (650-mm), suggesting that they become more numerous with growth. These thorns make dorsal surfaces of large *D. ukpam* extremely rough, and, as noted by Smith (1863), difficult to handle. Free-living specimens examined have one or two round, enlarged pearl spines on mediscapular region.

Neurocranium observed on radiographs but it and other skeletal parts obscured by thickness of disc and heavy covering of denticles in this species. Cranium apparently similar to that of *Himantura signifer* as described in Compagno and Roberts (1982), but with a straighter anterior margin to its nasal capsules.

Pelvic girdle (Fig. 10a-b) broadly arched, semicircular, relatively thick, with a medial anterior angle but no medial prepubic process. Lateral prepubic processes low, rounded, and lobate; iliac processes well-developed; ischial processes short. Five obturator foramina present on one specimen.

Claspers of mature male not available.

DISCUSSION

It has been known for some time that stingrays identified as *Dasyatis margarita* represent two species (Daget and Itlis 1965; Blache et al. 1970; Stehmann 1981). It appears that the first ichthyologist to become aware of this was the late J. Cadenat; he recognized that the two species differ greatly in weight, the one not exceeding 1 kg while the other attains easily 15–20 kg and perhaps much more (quoted in Daget and Itlis 1965: 15). The small species is *D. margaritella*, the

large one *D. margarita*. Both are common and widely distributed in shallow water along the coast of West Africa. Most accounts of *D. margarita* are based on *D. margaritella* or on both *D. margaritella* and *D. margarita*. *D. margaritella* is more common than *D. margarita* in museum collections and perhaps also in nature. We are unaware of any difference in habitat preference.

It is remarkable that such notable animals as freshwater stingrays remain so poorly known. We believe that they will be found in additional river basins in West Africa and that possibly additional freshwater species are present. We have heard that stingrays occur in the Sanaga basin in Cameroun, particularly in Lac Ossa, but have no material evidence for this. It is curious that no *Dasyatidae* have been reported from rivers west of Nigeria. This might be due to insufficient collecting.

A stingray was reported from the Cross River at Mamfe Pool by Sanderson (1937), but the specimen was not preserved, and the account is so extraordinary that we hardly know what to make of it. According to Sanderson, the ray was "diamond-shaped, like all fish of this class, and measured from the tip of one lateral point to the tip of the other, four feet eight inches; from the snout to the base of the tail, five feet eleven inches; and from the base to the tip of the tail, which had no fin, five feet two inches. Emerging from the upper edge of the tapering whip-like tail near its base was a long, straight, sharp spine or sting, one foot seven inches in length." He went on to say that the arrival of this monster altogether unhinged his sense of logic, so perhaps it also affected his ability to observe and record accurately. "That it was still alive and therefore undoubtedly caught in Mamfe Pool, as the natives stated, was almost incredible, because this bit of water was nearly three hundred miles from the sea. I therefore had to adjust myself to the idea that such things are true fresh-water animals indigenous to the great rivers of Africa. Why do not natural history books depict these fish instead of the everlasting crocodile?" Why not, indeed? Sanderson provides as good an answer as any: "We didn't want the brute because we were not collecting fish, but we photographed him alongside sundry natives and inanimate objects and purchased the sting." Unfortunately the photograph was not published and the sting had to be discarded: "When this sting got really dry it

split longitudinally and opened like a star, revealing a clear crystalline plug within. This substance gradually broke up under the damp atmospheric conditions; some of it dropped in water fizzed furiously. I could not find anything that would preserve it among our selection of travelling drugs and chemicals."

We have seen dried stings of various rays without observing anything like the disintegration reported by Sanderson, and suspect he had a few chuckles and perhaps something else while concocting this giant sting. The fishermen at Mamfe, who regularly catch *D. garouaensis*, maintained that it is the only species of ray in the Cross River from Mamfe to the Nigerian border and that the example caught and preserved during the junior author's visit was nearly as large as the largest they had ever caught. When shown a photographic print of *D. ukpam* they indicated that this species was unknown to them. Concerning sting size, the largest sting we have observed on a West African freshwater ray is under four inches. In *Dasyatis centroura*, which probably has the largest sting of any marine species in West Africa, the sting of a specimen with a disc width of four feet eight inches would be only about six or seven inches. We conclude that *D. garouaensis* is the only species of stingray in the Cross River in the vicinity of Mamfe.

Identification of a specimen of *D. garouaensis* from Lagos may indicate that the species occurs in Lagos Lagoon and in the rivers flowing into it. Unfortunately the specimen is not accompanied by information on habitat, and we cannot rule out the possibility that it was caught in the Niger River and transported to Lagos.

Although the title of the paper in which *D. ukpam* was described states that it lives in the Old Calabar River, and the text indicates that it lives as much as 150 miles upriver (Smith 1863), this is based on hearsay. It should be noted that the vernacular name "ukpam" or "okpam" is a generic term for stingrays. At Mamfe this name is employed by present-day speakers of the Man-yu and Ejagam languages for *D. garouaensis*.

The occurrence of an unidentified stingray in the Ogooué basin was first brought to our attention by an ichthyological colleague, Dr. Jacques Géry, who related to the junior author that he had observed two rays in the Ivindo near Makokou while collecting characins and other small fishes in 1964. The Ivindo flows into the Ogooué

near Booué, where one of our specimens of *D. ukpam* was collected, but there are some formidable waterfalls on the Ivindo below Makokou and the species there might be different. The Zaire locality for *D. ukpam*, Binda, is on a relatively narrow and swift-flowing portion of the lower Zaire (Congo) River about 100 km upriver from the mouth of the river at Banana and 35 km downriver from the end of the mainstream rapids of the lower Zaire River near Matadi. No stingrays are known from the interior of the Zaire or Congo basin. So far as we have been able to determine *D. garouaensis* and *D. ukpam* are the only living freshwater stingrays known from Africa.

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